OSIRIS: a three-dimensional, fully relativistic particle in cell code for modeling plasma based accelerators

R.A.Fonseca[1], L.O.Silva[1], F.S.Tsung[2], V.K.Decyk[2], W.Lu[2], C.Ren[2], W.B.Mori[2], S.Deng[3], S.Lee[3], and T.Katsouleas[3], and J.C.Adam[4]

[1] Instituto Superior Técnico, Lisboa, Portugal
[2] University of California, Los Angeles, USA
[3] University of Southern California, Los Angeles, USA
[4] École Polytechnique, Paris. France

We describe OSIRIS, a three-dimensional, relativistic, massively parallel, object oriented particle-in-cell code for modeling plasma based accelerators. Developed in Fortran 90, the code runs on multiple platforms (Cray T3E, IBM SP, Mac clusters) and can be easily ported to new ones. Details on the code's capabilities are given. We discuss the object-oriented design of the code, the encapsulation of system dependent code and the parallelization of the algorithms involved. We also discuss the implementation of communications as a boundary condition problem and other key characteristics of the code, such as the moving window, open-space and thermal bath boundaries, arbitrary domain decomposition, 2D (cartesian and cylindric) and 3D simulation modes, ion sub-cycling, energy conservation and particle and field diagnostics. Finally results from three-dimensional simulations of particle and laser wakefield accelerators are presented, in connection with the data analysis and visualization infrastructure developed to post-process the scalar and vector results from PIC simulations.